* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention -- a semi-conductor flip chip and a conductor -- the mounting approach of a semi-conductor flip chip of direct-connecting or medium connecting inter-electrode [of the circuit board] -- being related -- especially -- a semi-conductor flip chip and a conductor -- it is related with amelioration of the heat hardening work habits of the thermosetting resin binder which intervenes between the circuit boards.
[0002]
[Description of the Prior Art] the semi-conductor flip chip corresponding to a microminiaturization of recent years and a semiconductor device, improvement in the speed, high-frequency-izing, etc. by which the electrode bump was formed in the electrode pad of a semiconductor chip the purpose -- a face down condition -- a conductor -- the mounting approach of the semi-conductor flip chip directly mounted on the circuit board (INTAPOZA) is put in practical use. for example, it is indicated by JP,5-175280,A -- as -- a conductor -- the electrical installation of the connection terminal of the circuit board and the electrode pad of a semi-conductor flip chip a conductor, while penetrating the adhesion mold thermosetting thin film member which has covered the circuit board and being made an adhesion mold thermosetting thin film member -- heating -- the hardening shrinkage force -- the electrode bump of a semi-conductor flip chip -- a conductor -- while pressure-welding connection is made and forming an electric flow circuit in the connection terminal of the circuit board, it considers as the configuration which performs the closure which maintains a pressure-welding connection condition.
[0003] furthermore -- recently -- as the mounting approach of a semi-conductor flip chip -- a semi-conductor flip chip and a conductor -- the gap of the circuit board is filled up with a liquefied thermosetting resin binder, heat hardening of this is carried out, and the undershirt filling method which forms and closes a binder layer is proposed. While lowering the viscosity of a binder layer, improving the flow nature of a binder layer as this undershirt filling method and heightening a packing effect a conductor, in order to remove the void contained in the gas contained in the circuit board, or a binder layer Fix the circuit board and preheating is performed. the stage top heated by 60-80 degrees C -- a conductor -- a) after mounting by pressurizing a semi-conductor flip chip in the state of a face down The liquefied thermosetting resin binder heated by 60-80 degrees C from the tip of the needle of dispenser SHIRIJIN a semi-conductor flip chip and a conductor -- the approach of supplying to a gap with the circuit board and carrying out heat hardening with predetermined curing temperature -- b) -- a conductor -- into the central part in which the semi-conductor flip chip on the circuit board is carried The optimum dose ****** binder layer is formed for the liquefied thermosetting resin binder beforehand heated by 60-80 degrees C. Depending on whether it is the approach and ******** to which the semi-conductor flip chip by which Au ball bonding bump was formed in the electrode pad of a semiconductor chip is forced from a top in the state of a face down on a binder, and heat hardening of the binder layer is extended and carried out the electrode bump of a semi-conductor flip chip -- a conductor -- while making pressure-welding connection, the mounting approach of the semi-conductor flip chip which

closes these is put in practical use by the connection terminal of the circuit board.
[0004] And the thermosetting resin binder used for mounting of a semi-conductor flip chip For example, a principal component contains the filler of an about 2-micrometer particle with an epoxy resin. 150-170 degrees C and a coefficient of thermal expansion below at the glass transition point temperature Tg 33-45 ppm/degree C [the glass transition point temperature Tg] Many epoxy system thermosetting resin binders whose curing temperature which has a 110-120 ppm [/degree C] hardened material property when the glass transition point temperature Tg is exceeded, and has the property that viscosity is about 900-1100cps in the liquefied condition is 260 degrees C are used.
[0005] An example of the mounting approach of a semi-conductor flip chip using the hardening approach of Above b is explained. for example, the conductor which consists of a resin substrate when forming a semiconductor device 30, as shown in drawing 5 (A) -- although the semi-conductor flip chip 32 is mounted in the state of a face down on the circuit board 31, the semi-conductor flip chip 32 in which the electrode bump 35 who two or more electrode pads 34 of the (1) semiconductor chip 33 boil the process, respectively, for example, consists of an Au ball bonding bump was formed is prepared (electrode bump formation process).
(2) the copper foil of both sides of the glass BT resin substrate (with the resin substrate which uses bismaleimide and triazine as a principal component, they are glass transition point temperature Tg=180-230 degree C and the coefficient of thermal expansion of alpha= 13-17 ppm/degree C) which is an example of an organic system copper-clad resin substrate -- etching processing -- carrying out -- a conductor -- the predetermined conductor which has a lead and the semi-conductor loading section -- the conductor of for example, the glass BT resin base in which the circuit pattern 36 was formed -- prepare the circuit board 31 (conductor circuit board formation process).
(3) the conductor -- form the optimum dose ****** binder layer 37 in the central part in which the semi-conductor flip chip 32 on the circuit board 31 is carried for an epoxy system thermosetting resin binder beforehand (binder spreading process).
(4) the conductor with which the binder layer 37 was formed -- while fix the circuit board 31 to a heating stage, carrying out a temperature up to about 80 degrees C, lowering the viscosity of the binder layer 37, improving the flow nature of the binder layer 37 and heightening a packing effect -- a conductor -- perform the preheating for removing the void contained in the gas contained in the circuit board 31, or the binder layer 37 like a heat process beforehand.
[0006] (5) the conductor by which the preheating was carried out -- the binder layer 37 of the circuit board 31 -- the semi-conductor flip chip 32 -- positioning installation -- carrying out -- predetermined welding pressure -- this -- pressing -- the binder layer 37 -- extending -- a conductor -- make the connection terminal pad 38 prepared in the circuit board 31 make pressure-welding connection of the electrode bump 35, and form an electric flow circuit in it (mounting process).
(6) As shown in drawing 6 , heat, where the semi-conductor flip chip 32 is pressurized, and raise the curing temperature of a 260-degree C epoxy system thermosetting resin binder in 3 seconds (heating process).
(7) Hold for 11 seconds with the curing temperature (260 degrees C) of an epoxy system thermosetting resin binder, and make 95 - 100% of rates of hardening harden the binder layer 37 (heat-curing process).

(8) Cool and leave it at 80 degrees C in 20 seconds after that (cooling process).
thus, the electrode pad 34 of the semi-conductor flip chip 32 and a conductor -- the condition of having held these while the electric flow circuit between the connection terminal pads 38 of the circuit board 31 was formed -- the semi-conductor flip chip 32 -- a conductor -- closure mounting is carried out at the circuit board 31.
[0007]
[Problem(s) to be Solved by the Invention] however, the semi-conductor flip chip 32 and a conductor -- the conductor which consists of a glass BT resin substrate which is an example of an organic system resin substrate when heat curing of the liquefied binder layer 37 with which the gap with the circuit board 31 was filled up is carried out on the above-mentioned conventional heat hardening conditions

and it mounts the semi-conductor flip chip 32 -- since the circuit board 31 goes up at 260 degrees C of the curing temperature of the binder layer 37 -- a conductor -- temperature becomes high from the glass transition point temperature Tg (180-230 degrees C) of the circuit board 31. therefore, a conductor -- it softens and an arrow head A shows the circuit board 31 to drawing 5 (A) -- as -- a conductor -- after elongation has arisen in the circuit board 31, the binder layer 37 reaches the predetermined rate (95 - 98%) of hardening, and the binder layer 37 carries out hardening contraction. and it cools -- having -- a conductor -- if temperature falls from the glass transition point temperature Tg (180-230 degrees C) of the circuit board 31 -- a conductor -- the circuit board 31 also carries out hardening contraction. and a conductor -- while the stress resulting from a coefficient-of-thermal-expansion difference remains to the adhesion interface of the circuit board 31, the binder layer 37, and the semi-conductor flip chip 32 and the binder layer 37, curvature occurs according to the shrinkage force shown in drawing 5 (B) by the arrow head B. Furthermore, stress remains also to the pressure-welding joint of the connection terminal pad 38 and the electrode bump 35 who lack rigidity in size at flexibility.

[0008] As the result, residual stress was released by heating of PCT (Pressure Cracker Test: the temperature of 110 degrees C, 85% of humidity, 500 hours), and TCT (Temperature Cycle Test:125 degree C / -55 degrees C, 1000Cycle), and there was a problem that it could not respond to reliability trials, such as surface smoothness (curvature), adhesion, and electrical installation nature, (success). Therefore, in order to correspond to a reliability trial, to raise the stress reduction and connection resilience in each adhesion interface was needed. This invention was made in view of such a situation, and raises the stress reduction and connection resilience in an adhesion interface, generating of the defect of dimensional accuracy and display flatness (elapid nullity) is prevented, and it aims at offering the mounting approach of a semi-conductor flip chip which can respond to a reliability trial.

[0009]

[Means for Solving the Problem] The mounting approach of the semi-conductor flip chip concerning this invention in alignment with said purpose the conductor equipped with two or more connection terminals on the organic system resin substrate -- the conductor with which the circuit pattern was formed -- on the surface of the circuit board Temporary adhesion which carries out positioning loading of the semi-conductor flip chip equipped with two or more electrode bumps corresponding to the connection terminal of the circuit board in the state of a face down on a binder layer is performed. a thermosetting resin binder -- applying -- a binder layer -- forming -- a conductor -- Press a semi-conductor flip chip with predetermined welding pressure, and a binder layer is extended. the condition of having pressurized said semi-conductor flip chip after making the connection terminal making pressure-welding connection of the electrode bump and forming an electric flow circuit in it -- a binder layer -- phase heat hardening processing of the count of necessary -- carrying out -- a semi-conductor flip chip -- a conductor -- it is considering as the configuration mounted on the circuit board.

[0010] As mentioned above, the binder layer by which carried out predetermined time maintenance with predetermined temporary curing temperature, and temporary heat hardening processing was carried out by performing phase heat hardening processing of the count of predetermined at the necessary rate of hardening a conductor, even if it carries out predetermined time maintenance of the binder layer with this predetermined curing temperature and carries out this heat hardening processing after that at the necessary rate of hardening, in order to function as reinforcing the circuit board a conductor -- stretch of the circuit board -- decreasing -- a semi-conductor flip chip and a conductor -- the residual stress of the connection interface of the circuit board and the pressure-welding joint of a connection terminal and an electrode bump is reduced, and the curvature of the semiconductor device after mounting and deformation can be prevented.

[0011] In the mounting approach of the semi-conductor flip chip concerning this invention phase heat hardening processing of a binder layer The 1st phase heat hardening processing which raises the temporary curing temperature from which the rate of hardening of a binder layer becomes 70 - 80%, and temporary curing temperature is maintained [1st] between predetermined time, and stiffens a binder layer, Furthermore, it is good also as a configuration which consists of the 2nd phase heat hardening processing which raises this curing temperature from which the rate of hardening of a binder layer

becomes 90 - 100%, and between predetermined time and this curing temperature are maintained [2nd], and stiffens a binder layer.

[0012] In this case, it considers as the configuration mount by performing phase heat hardening processing by the 1st phase heat hardening processing and the 2nd phase heat hardening processing. For example, this curing temperature heats the binder layer which is 260 degrees C for 2 seconds, and carries out a temperature up to the temporary curing temperature of 200-240 degrees C (preferably 220 degrees C) lower than this curing temperature. the 1st phase heat hardening processing which maintains this condition for 5 seconds and hardens a binder layer to 70 - 80% of rates of hardening -- carrying out -- a conductor, since the circuit board is reinforced and unified by the binder layer of 70 - 80% of rate of hardening Then, a temperature up is carried out to 260 degrees C of this curing temperature by the 2nd phase heat hardening processing, and even if it makes the predetermined rate of hardening harden a binder layer, it becomes possible to reduce the residual of stress. in addition, the rate of hardening of a binder layer -- less than 70% of low rate of hardening -- a conductor -- since the circuit board is not substantially reinforced by the binder layer -- the conductor in the 2nd phase heat hardening processing -- deformation of the circuit board does not become small.

[0013] the mounting approach of the semi-conductor flip chip concerning this invention -- setting -- this curing temperature of a binder layer -- a conductor -- it may be set up more highly than the glass transition point temperature of the circuit board. As mentioned above, since a hardening reaction is further promoted by setting up this curing temperature of a binder layer highly, compaction of the setting time is attained and compaction of the mounting time amount of a semi-conductor flip chip is attained. Furthermore, since the setting time is shortened, the damage given to the semi-conductor flip chip by whenever [stoving temperature] can be reduced.

[0014]

[Embodiment of the Invention] Then, referring to the attached drawing, it explains per gestalt of the operation which materialized this invention, and an understanding of this invention is presented. The side elevation of the semiconductor device manufactured here using the mounting approach of the semi-conductor flip chip which drawing 1 requires for the gestalt of 1 operation of this invention, The side elevation of a semiconductor package in which drawing 2 (A) and (B) are formed at the process in the middle of the mounting approach of this semi-conductor flip chip, respectively, a conductor -- the top view of a circuit board frame, the explanatory view showing the rate of hardening of the binder which consists of heat-curing resin which uses drawing 3 for the mounting approach of this semi-conductor flip chip, and drawing 4 are the explanatory views showing the time amount of the hardening process of the mounting approach of this semi-conductor flip chip, and the relation of a temperature change.

[0015] As shown in drawing 1 , the semiconductor device 10 formed using the mounting approach of the semi-conductor flip chip concerning the gestalt of 1 operation of this invention By performing etching processing to the copper foil of the glass BT resin copper-clad substrate which has copper foil on the front face by about 0.1-0.4mm which is an example of an organic system resin substrate a predetermined conductor -- the conductor which uses as the base the glass BT resin substrate with which the circuit pattern 11 (refer to drawing 2 (A) and (B)) was formed -- it has the circuit board 12. and a conductor -- the circuit pattern 11 -- a center section -- the dummy pad 13 -- having -- the conductor of plurality [perimeter / the] -- lead 14 -- arranging -- each -- a conductor -- the internal connection terminal pad 15 which are some connection terminals with which gilding was given is formed in the front face of the end section by the side of the semi-conductor loading side (top face) of lead 14. moreover, a conductor -- the external connection terminal land 16 which are some connection terminals arranged in the shape of an array is formed in the component-side (inferior surface of tongue) side of the circuit board 12, and the external connection terminal land 16 is electrically connected with the internal connection terminal pad 15 through the through hole 17.

[0016] a conductor -- on the circuit pattern 11, the heat-curing resin binder (henceforth a binder) which consists of heat-curing resin which makes an epoxy resin a subject is applied, and the binder layer 18 which has the stiffened necessary hardened material property is formed. In addition, as shown in drawing 3 , when it heats for 5 seconds at 220 degrees C (temporary curing temperature), the rate of

hardening becomes 70 - 80% (an average of 75%), and when it heats for 5 seconds at 260 degrees C (this curing temperature), the heat-curing resin which makes an epoxy resin a subject is constituted so that the rate of hardening may become 90 - 100%. Moreover, a binder makes an epoxy resin a subject, it considers as the thermosetting epoxy resin binder of a configuration of that a filler, a curing agent, and a reactant diluent are included, and curing temperature is 260 degrees C. When glass transition point temperature is 150 degrees C - 170 degrees C and a coefficient of thermal expansion is below glass transition point temperature, and 33-45 ppm/degree C It has a 110-120 ppm [/degree C] hardened material property at the time beyond glass transition point temperature, and has the property that viscosity when still more liquefied is 900-1100cps.

[0017] Furthermore, the semi-conductor flip chip 22 which formed the electrode bump 21 who formed two or more electrode pads 20 formed in two or more active element sides of a semiconductor chip 19 downward [20], i.e., an electrode pad, and who consists of an Au ball bonding bump as an example on the binder layer 18 is mounted in the condition of a face down. and the semi-conductor flip chip 22 and a conductor -- the circuit board 12 is joined by the binder layer 18, and the semiconductor device 10 which carried out the resin seal is constituted. this time -- the electrode bump 21 -- the binder layer 18 -- a conductor -- while mechanical contact is carried out and forming an electric flow circuit in the internal connection terminal pad 15 prepared in the lead 14, the binder layer 18 is hardened, holds an electric flow circuit, and combines electrical installation and an under-filling function.

[0018] The manufacture approach of the semiconductor device using the mounting approach of the semi-conductor flip chip which starts the gestalt of 1 operation of this invention here is explained referring to drawing 4 . a semiconductor device 10 -- a bump formation process and a conductor -- a circuit board formation process and the binder layer spreading process which constitutes the mounting approach of a semi-conductor flip chip -- a heat process should pass a mounting process, the 1st phase heat hardening down stream processing, the 2nd phase heat hardening down stream processing, a cooling process, and a division process more nearly beforehand -- it is manufactured. That is, the semi-conductor flip chip 22 in which the electrode bump 21 who consists of an Au ball bonding bump was formed is prepared for each of two or more electrode pads 20 of the (1) semiconductor chip 19 (bump formation process).

(2) performing etching processing to the copper foil of the glass BT resin copper-clad substrate (glass transition point temperature Tg=180-230 degree C, coefficient of thermal expansion of alpha= 17 ppm/degree C) which has copper foil at the front rear face which is an example of an organic system resin substrate -- a predetermined conductor -- the conductor which uses as the base the glass BT resin substrate with which two or more circuit patterns 11 have been arranged the shape of a strip of paper (refer to drawing 2 (A), and (B)), and in the shape of a matrix -- preparing the circuit board frame 23 (conductor circuit board formation process).

[0019] (3) a conductor -- form the optimum dose ****** binder layer 18 for the binder which consists of a thermosetting liquefied epoxy resin beforehand on each dummy pad 13 of the circuit board frame 23 (binder layer spreading process).

(4) the conductor with which the binder layer 18 was formed -- while fix the circuit board frame 23 to a heating stage, carrying out a temperature up to about 80 degrees C, lowering the viscosity of the binder layer 18, improving the flow nature of the binder layer 18 and heightening a packing effect -- a conductor -- perform the preheating for removing the void contained in the gas contained in the circuit board frame 23, or the binder layer 18 like a heat process beforehand.

(5) the conductor by which the preheating was carried out -- after carrying out positioning installation of the semi-conductor flip chip 22 and performing temporary adhesion in the binder layer 18 of the circuit board frame 23, press this with predetermined welding pressure, extend the binder layer 18, make the internal connection terminal pad 15 make pressure-welding connection of the electrode bump 21, and form an electric flow circuit in it (mounting process).

[0020] (6) Next, perform the temporary heat hardening processing which performs 1st heating which raises the temporary curing temperature of the 220-degree C binder layer 18 in 2 seconds, maintains for 5 seconds with the temporary curing temperature, advances a hardening reaction, and performs the 1st

heat curing of 75% of rates of hardening where the semi-conductor flip chip 22 is pressurized, i.e., the 1st phase heat hardening processing, (1st phase heat hardening down stream processing).
(7) Perform 2nd heating which raises this curing temperature of the 260-degree C binder layer 18 in 1 second after performing 1st phase heat hardening processing. This heat hardening processing in which maintain the temperature of 260 more degrees C for 5 seconds, advance a hardening reaction, and the 2nd heat curing of 100% of rates of hardening is performed, namely, the 2nd phase heat hardening processing -- carrying out -- the semi-conductor flip chip 22 -- a conductor -- two or more semiconductor packages 24 closed on the circuit board frame 23 are formed (2nd phase heating down stream processing).
(8) Cool and leave a semiconductor package 24 at 80 degrees C in 20 seconds after that (cooling process).
(9) the conductor with which two or more semiconductor packages 24 were formed -- form the semiconductor device 10 which carried out the dicing cut of the circuit board frame 23 every semi-conductor flip chip 22, and was divided separately (division process).
[0021] pass the above-mentioned process -- a conductor -- the circuit board frame 23 and the semi-conductor flip chip 22 -- as a semiconductor package 24 -- the semi-conductor flip chip 22 and a conductor -- where the electric flow circuit between the internal connection terminal pads 15 of the circuit board 12 is held, the closure is carried out in one, and the semiconductor device 10 which it was further divided every semi-conductor flip chip 22, and the external connection terminal land 16 exposed to the rear-face side is formed. in addition, about ten semiconductor devices formed using the mounting approach of the semi-conductor flip chip concerning this invention Temperature PCT (Pressure Cracker Test) of a reliability-trial item 110 degrees C, In the result performed on the conditions whose humidity is 85%, and whose atmospheric pressures are 1.2atm(s) and 500 hours, total (10/10) is passing. Even result [of having performed TCT (Temperature Cycle Test) on condition that the temperature of 125 degrees C / -55 degrees C, and 1000Cycle], total (10/10) was passing, and the high semiconductor device of quality was obtained.
[0022] As mentioned above, although the mounting approach of the semi-conductor flip chip concerning the gestalt of 1 operation of this invention has been explained, this invention is not limited to a configuration given in the gestalt of the aforementioned operation at all, and also includes the gestalt and modification of other operations which are considered within the limits of the matter indicated by the claim. for example, a conductor -- after mounting a semi-conductor flip chip out of the approach of forcing from a top the semi-conductor flip chip which has every optimum-dose ****** and Au ball bonding bump for a binder layer beforehand on the dummy pad prepared in the central part in which the semi-conductor flip chip on the circuit board is carried, and extending and hardening a binder layer -- the tip of the needle of dispenser SHIRIJIN to a binder layer -- a conductor -- it may be the approach of supplying the gap between the circuit board and a semi-conductor flip chip, and stiffening a binder layer.

[0023] furthermore -- the gestalt of said operation -- the conductor of the glass BT resin base -- although considered as the configuration using the circuit board -- a conductor -- as the circuit board -- glass-fabrics epoxy -- a conductor -- it can also consider as the configuration using the circuit board (4 grade: FR- 5) and the glass-fabrics polyester circuit board (grade: FR-6). Moreover, although the gestalt of said operation explained the COB (Chip On Board) type which carries a semi-conductor flip chip on an organic system resin substrate, and forms a semiconductor device The mounting approach of the semi-conductor flip chip concerning this invention COC which piles up a semi-conductor flip chip on a semiconductor chip (Chip On Chip), WOW which piles up the wafer with which the semi-conductor flip chip was arranged on the wafer with which the semiconductor chip was arranged (Wafer On Wafer), It is applicable also to COF (ChipOn Frame) which carries a semi-conductor flip chip in BGA (Ball Grid Array) type CSP (Chip Scale Package), a leadframe, etc.
[0024]
[Effect of the Invention] In the mounting approach of a semi-conductor flip chip according to claim 1 to 3 a conductor -- the conductor which consists of an organic system resin substrate with which the circuit

pattern was formed -- on the surface of the circuit board Apply a thermosetting resin binder, form a binder layer, and positioning loading of the semi-conductor flip chip is carried out in the state of a face down on a binder layer. While pressing a semi-conductor flip chip with predetermined welding pressure and extending a binder layer, after forming an electric flow circuit, where said semi-conductor flip chip is pressurized, phase heat hardening processing of the count of necessary is performed in a binder layer. therefore, a binder layer is hardened to the rate of hardening predetermined by temporary heat hardening processing (for example, 70 - 80%) -- having -- a conductor -- even if it functions as reinforcing the circuit board and hardens at this hardening process -- a semi-conductor flip chip and a conductor -- an adhesion interface with the circuit board and the electrode bump of a semi-conductor flip chip, and a conductor -- while the residual stress of the pressure-welding joint of the connection terminal of the circuit board is reduced, bond strength is raised and curvature and deformation can be prevented in the state of a semiconductor device. Consequently, the mounting approach of a semi-conductor flip chip with the high dependability which prevents the defect of dimensional accuracy or display flatness can be offered.

[0025] It sets especially to the mounting approach of a semi-conductor flip chip according to claim 2. The 1st phase heat hardening processing which phase heat hardening processing of a binder layer maintains [1st] the temporary curing temperature from which the rate of hardening of a binder layer becomes 70 - 80%, and stiffens a binder layer, Furthermore, since it is considering as the configuration which consists of the 2nd phase heat hardening processing which this curing temperature from which the rate of hardening of a binder layer becomes 90 - 100% is maintained [2nd], and stiffens a binder layer the 1st phase heat hardening processing -- a conductor -- even if the unification with the circuit board and a binder layer progresses and a binder layer carries out actual hardening by the 2nd phase heat hardening processing, the residual stress of a semiconductor device is reduced and curvature and deformation can be prevented.

[0026] the mounting approach of a semi-conductor flip chip according to claim 3 -- setting -- this curing temperature of a binder layer -- a conductor -- since it is set up more highly than the glass transition point temperature of the circuit board, by setting up the curing temperature of a binder layer highly, a hardening reaction is promoted further, the compaction of the setting time of it is attained, and the compaction of the mounting time amount of a semi-conductor flip chip of it is attained. Furthermore, since the setting time is shortened, the damage given to the semi-conductor flip chip by whenever [stoving temperature] can be reduced, and the dependability of a semiconductor device can be raised.

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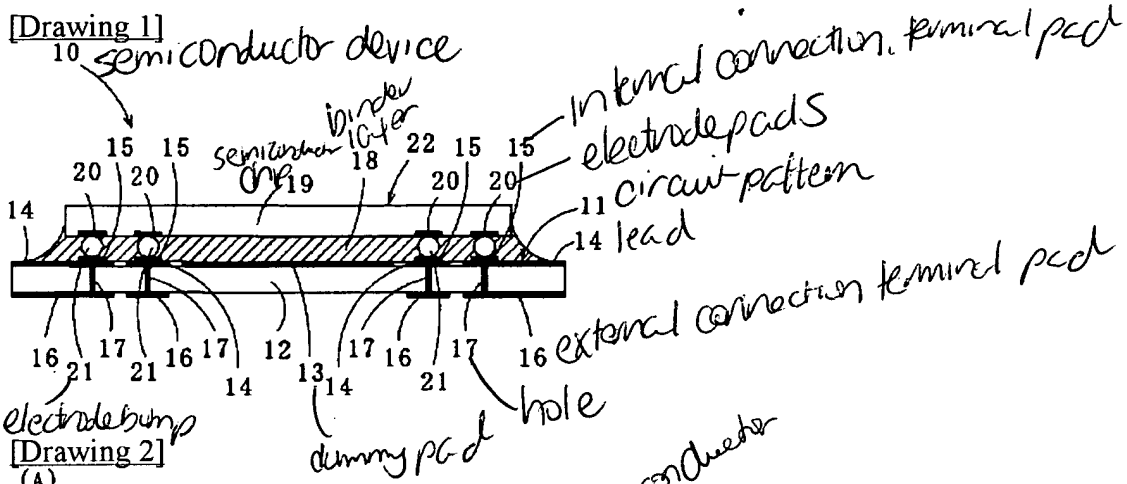
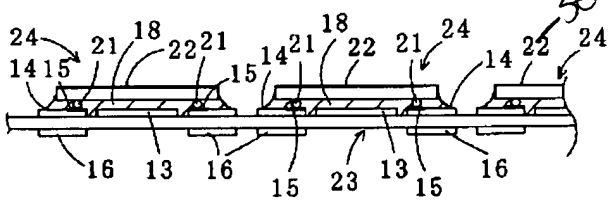
DRAWINGS

[Drawing 1]



[Drawing 2]

(A)



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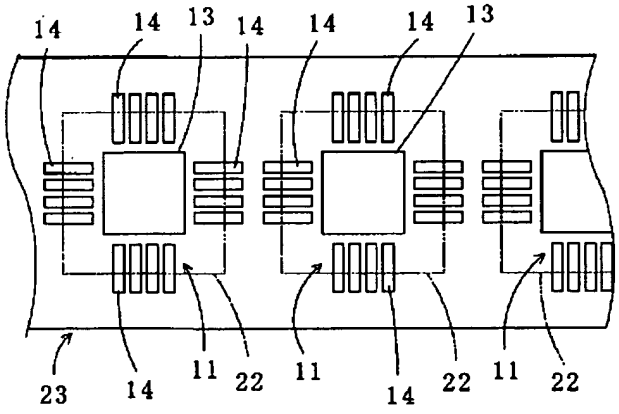
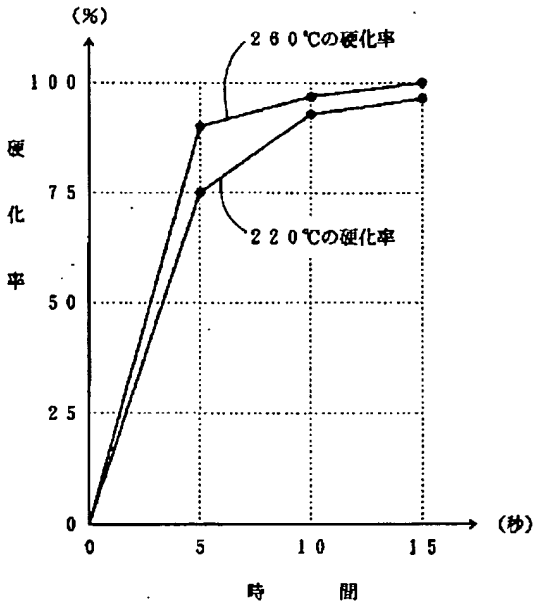
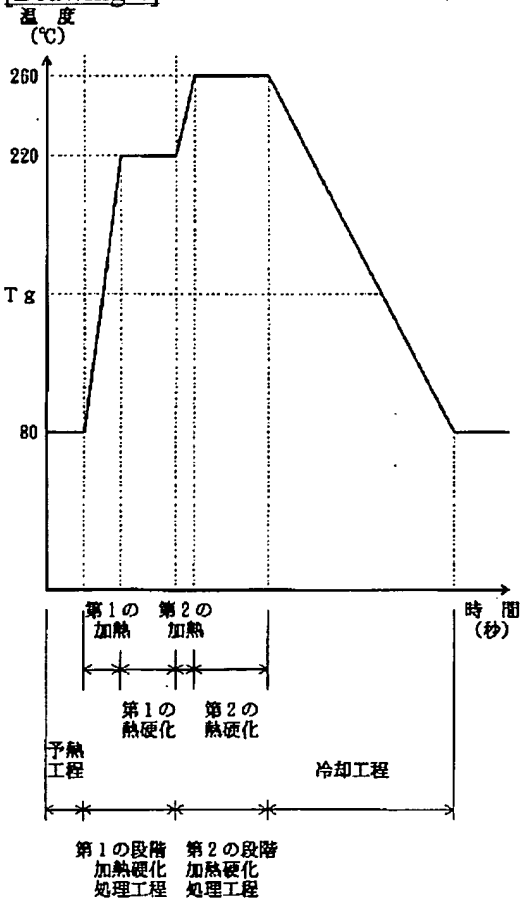


[Drawing 3]

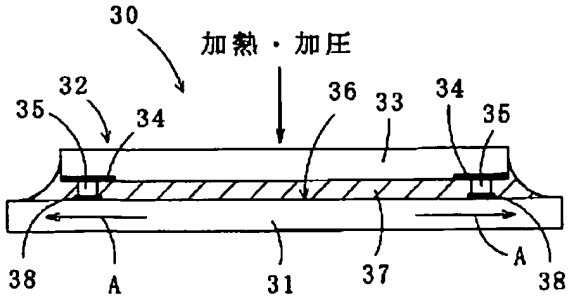


[Drawing 4]



[Drawing 5]

(A)



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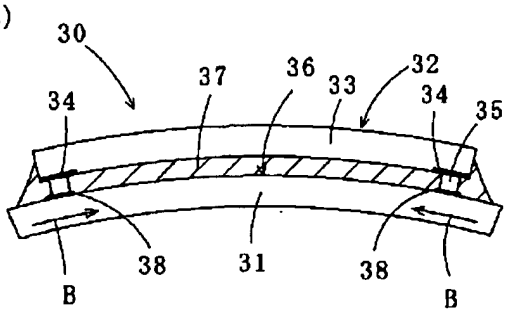
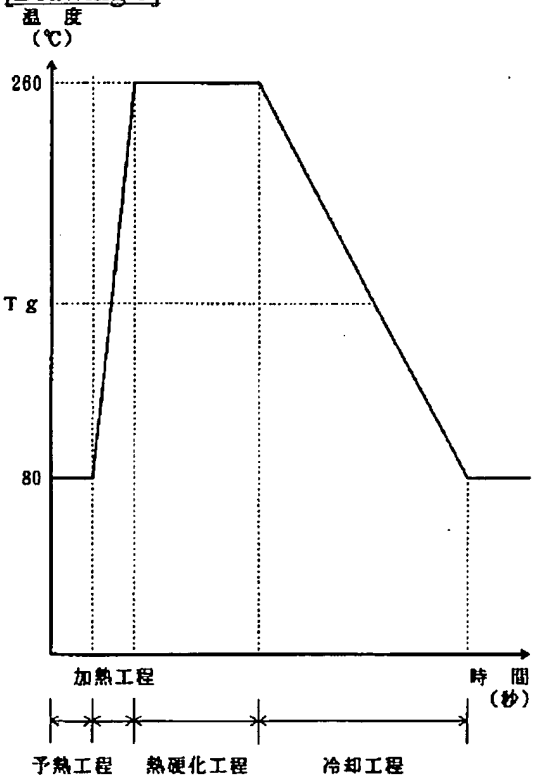


[Drawing 6]



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